

FREQUENTLY ASKED QUESTIONS (FAQS) ON ANTHRAX FOR WILDLIFE MANAGERS

Prepared by Peter C.B. Turnbull (peterturnbull@tesco.net)

With acknowledgements to the following for their most helpful input:

Roy Bengis, Sarah Clegg, Carla Conradie, Martin Hugh-Jones, Arnold F. Kaufmann, Richard Kock, Morris Kilewo, Belinda Lowe, Sean Shadomy and the following groups and institutions:



IUCN
The World Conservation Union


SPECIES SURVIVAL COMMISSION

ZSL
LIVING CONSERVATION



Terminal haemorrhage
in a blue wildebeest



Taking a sample of
blood for diagnosis



The epizootic of anthrax in
Luangwa hippos, 1987

Quick search

- Abundance of animals II.3.1; II.5; II.6; II.7.1; II.7.3.1
- Action
 - effectiveness II.3
 - plans II.4; II.7; II.7.3
- Advice VI.1
- Advisory material II.7.3.1; II.7.3.2; VI.3
- Alkalinity II.6
- Animal
 - anthrax I.1, I.2, II
 - density - see abundance
 - products I.3; III.1; III.10
 - risks to IV
- Antibiotics III.11; III.12; III.18; IV.5
- Biological warfare V.2; V.3
- Bioterrorism V.2, V.3
- Bleach II.8.2
- Bones I.1; III.1; III.10
- Browsers I.2
- Budgets II.7.3.1
- Burning
 - bush II.7.3.1
- Calcium II.6
- Carcass
 - disposal II.7.3.1, II.7.3.3
 - management II.7.3.1; II.7.3.3, II.9.2
- Carriion II.7.3.3; II.9.2
- Cause of
 - anthrax I.1
 - outbreak - see source
- Climate II.6
- Chlorination III.14
- Collection of samples/specimens II.8.2
- Communities local II.7.3.1
- Contagiousness (human) III.8; III.9
- Control II.4; II.7
 - burning bush/brush II.7.3.1
 - insects II.7.3.1
 - vaccination II.7.3.1
 - vulture diversion II.7.3.1
- Cooking III.16
- Cutaneous anthrax III.1; III.2.1; III.2.2; III.3; III.4; III.7; III.13
- Data recording II.8
- Decontamination II.7.3.1
- Density of animals - see abundance
- Detection II.7.2; II.7.3.1; II.8
- Diagnosis
 - animal II.7.2; II.8.1
 - human III.4; III.7
- Discard - see disposal
- Disinfection II.7.3.1; III.10; III.12
- Disposal
 - carcass II.7.3.1; II.7.3.3; II.7.3.4
 - samples/sampling materials II.8.2
- Dose (infectious, human) III.10; III.13; V.3
- Drinking water - see water
- Drought II.6
- Duration of outbreak II.3
- Educational material II.7.3; II.7.3.1 - see also information
- Effectiveness of action II.3
- Endangered species - see valuable species
- Eradication V.1
- Eschar III.2.2
- Exacerbating factors II.7.3.3; II.9.2
- Experts VI.2
- Flies II.1; II.7.3.1; II.7.3.3; II.9.2; III.1; III.10; III.13; IV.2
- Flu-like symptoms III.5; III.7;
- Food safety II.7.3.1; III.5; III.10; III.16
- Gastrointestinal anthrax - see ingestion anthrax
- History II.2
- Human anthrax I.3; III
- Incubation period
 - animal IV.4
 - human III.3
- Incineration
 - carcasses III.16; V.1
 - (clothes) III.12
- Infectiousness - see contagiousness
- Infectious dose (human) III.10
- Information VI
- Ingestion anthrax III.2.1; III.2.2; III.3; III.4; III.7 III.8
- Inhalation anthrax III.2.1; III.2.2; III.3; III.4; III.7; III.8
- Insects II.1; II.7.3.1; II.7.3.3; II.9.2; III.10; III.13; IV.2
- Isolation
 - animals IV.2
 - humans III.9
- Grazers I.2
- Hides I.1; III.1; III.10
- Labelling samples/specimens II.8.2
- Lime II.7.3.4
- Livestock
 - in general I.2
 - in relation to anthrax in wildlife II.7.3.3; II.9.2; II.10
- Local communities II.7.3.1; II.7.3.2; II.12
- Management
 - areas II.9
 - of outbreaks II.4; II.6; II.7.3.3
 - sustainable development areas II.9
- Meat (from animals dead from anthrax) III.10; III.12; III.16
- Medical services II.7.1; II.7.3.1; II.12; III.18
- Milk III.17
- Occupational exposure III.1

- Occurrence I.1
- Oropharyngeal anthrax - see ingestion anthrax
- Overabundance - see abundance
- Plans of action II.7.3
- Personnel
 - personal protection II.7.3.1; III.10
 - risks II.6
 - training II.7.1; II.7.3.2
- Precious species - see valuable species
- Preparedness II.7.3.1
- Prevention II.4; II.9.1; III.18
- Pets I.2; II.8.2; IV.1; IV.2
- Prophylaxis II.7.3.1
- Protection
 - of animals IV.5
 - clothing II.7.3.1; III.10
 - dressing wounds III.10
- Public health services II.7.1; II.7.3.1; II.12; III.12
- Pulmonary anthrax III.2.1; III.2.2
- Quarantine
 - animals IV.4
 - humans III.9
- Quicklime II.7.3.4
- Rain II.3; II.6
- Reasons for outbreak - see source of outbreak
- Repeat outbreaks II.5
- Risk
 - to animals IV
 - factors II.4, II.6
 - of death (humans) III.7
 - to humans III
 - to livestock IV.2
- Samples for diagnosis II.8.1; II.8.2
- Scavengers II.7.3.1; IV.1.2
- Signs
 - of anthrax in animals II.2; IV.2
 - in humans III.2; III.3; III.5
 - warning signs of potential outbreak II.7.1
- Soil II.6
- Source of infection/outbreak I.1; II.1; II.9.2;
- Specimens for diagnosis II.8.2
- Specialist centres II.7.3.1; II.7.3.3; II.9.2
- Species affected I.2
- Spores II.8.2; V.2
- Serology II.7.3.1
- Soil II.6; III.15
- Spread II.1; II.7.3.2
- Staff - see personnel
- Strains II.7.3.1
- Surveillance II.7.1; II.7.3.1
- Symptoms
 - Animals II.2; IV.2
 - Humans III.2.1; III.2.2, III.3; III.5
- Tourists II.7.3.1; II.7.3.2
- Transmission
 - Animal II.1; IV.2
 - General I.1
 - Human III.8
 - Wildlife II.1
- Transport of specimens/samples II.8.2
- Treatment
 - animals IV.3 ; IV.5
 - humans III.6; III.7; III.11;
- Vaccination
 - core II.7.3.1; II.10
 - effectiveness II.7.3.3; IV.6
 - and eradication V.1
 - humans III.18
 - livestock IV.2; IV.5
 - methods II.10.2
 - ring II.7.3.1
 - source of vaccine II.10.3
 - wildlife II.7.3.1; II.10
- Valuable species II.10.1
- Veterinary services II.7.1; II.7.2; II.7.3.1; II.12; III.12; IV.2
- Vultures II.1
 - diversion II.7.3.1
- Water
 - Drinking II.7.3.1; III.14
 - Safety II.7.3.1
 - and transmission II.1
- Weather II.6
- Wind II.1
- Wool I.1

I. General

I.1 Q. What is anthrax? What causes it?

A. Anthrax is a disease caused by a bacterium called *Bacillus anthracis*. The disease has featured in records since ancient times and still occurs regularly in both animals and humans in many parts of the world, including most countries of sub-Saharan Africa and in central Asia, several southern European countries and certain regions of the Americas and Australia. Sporadic cases or outbreaks in animals occur elsewhere, usually representing its importation on contaminated materials of animal origin (hides, wool, bones, bonemeal, etc.) from endemic countries and cycling of the *Bacillus anthracis* from these to indigenous livestock via effluent from premises where such animal products are processed.

I.2 Q. Which animals can get it?

A. It is primarily a disease of grazing or browsing mammals but all warm-blood species can contract it.

Among livestock, it is most commonly reported in cattle, sheep, goats and horses, but outbreaks in pigs and some more exotic species, such as mink, can occur. It is not a disease of poultry. Pet dogs and cats are generally not readily affected.

Among wildlife, it is most commonly reported in zebra, greater and lesser kudu, waterbuck, roan antelope, wildebeest, springbok, elephant, impala, oryx, and giraffe, although geographical differences are seen in the species most affected in any one locality. In northwest Canada, substantial outbreaks have occurred in wood bison.

I.3 Q. Can humans get it?

A. Yes although they are regarded as fairly resistant to infection. Normally humans are infected incidentally, almost always acquiring the disease directly or indirectly from infected animals, when handling, or eating meat from, the carcasses of animals that have died of anthrax, or through occupational exposure to animal products contaminated with anthrax spores.

II. Anthrax in wild animals

II.1 Q. How do wild animals get infected with anthrax?

A. It is not always clear how an animal has contracted anthrax. It is assumed that, in the case of sporadic cases, grazing animals generally acquire the disease by ingesting spores when grazing over sites where previous victims of the disease died and deposited the spores after death. Licking of bones (pica or osteophagia) from animals that died of anthrax may result in cases or outbreaks. In Africa, the most accepted theory for browsers (giraffe, kudu, etc) is that flies (e.g blowflies) feeding off the carcasses fly to leaves of nearby trees and shrubs and deposit anthrax spores there. Browsing animals become infecting when eating these leaves. Biting flies are suspected of transmitting anthrax amongst wild animals and of playing important roles in epidemics.

The extent to which wind, water, etc., spread the disease is still poorly defined, but these are thought to be generally of little consequence. Man-made “still” water dams, boreholes with drinking troughs and stagnant drainage areas have been found to become contaminated following bathing by vultures after feeding on anthrax carcasses and winged scavengers may play an important role in spreading the disease in certain ecosystems. Apart from the case of carnivores scavenging on anthrax carcasses and occasionally succumbing to the disease, animal-to-animal transmission is not a common occurrence.

II.2 Q. What are the signs and symptoms of anthrax in wild animals?

A. Unexpected sudden death is characteristic of anthrax in animals. Bleeding from the nose, mouth and anus is common but not invariable. Apart from these, you are dependent on the history of the region. Has anthrax occurred here in the past? Has it occurred in an adjacent area recently?

II.3 Q. How long is our outbreak likely to last?

A. Obviously this depends on circumstances that exist, particularly the numbers and densities of the most susceptible species and the areas concerned. If no action is taken, then it may last until the susceptible populations have died out or come close to that. This depends on the densities of those populations and the area within which they circulate. In this worst case scenario, it can last for many weeks. The reduction of duration brought about by actions taken depends on the effectiveness of those actions. As it is not always easy to understand how the outbreak is being spread, the effectiveness of actions cannot be readily predicted. If, for example, flies are heavily involved in the spread, then actions aimed at keeping apart animals and flies that have fed on anthrax carcasses are going to have some effect. If vaccination of animals 4 or more days ahead of the advancing outbreak can be achieved, this is likely to curtail the outbreak considerably. The sorts of actions that may be taken are covered in II.7.3.1. When effective, interventions may bring the outbreak under control in 2 to 4 weeks.

The arrival of rains (and frosts in northern latitudes) may bring the outbreak to a halt naturally, especially if heavy. Limited data indicate that more animals are exposed than die and therefore increasing herd immunity may play a part in both stopping epidemics and in limiting outbreaks in the ensuing year or two years.

II.4 Q. What can be done to stop wildlife anthrax outbreaks?

A. Action to stop an outbreak has to be divided into two categories, **prevention** of the outbreak occurring in the first place, or of spreading and **control** once an outbreak has started. Prevention involves identifying the risk factors and warning signs outlined in II.6 and taking appropriate notice of these and actions to minimize them. Control involves following a well-designed action plan once an outbreak has begun. This is dealt with in detail in II.7.3.2.

II.5 Q. Can the outbreak re-kindle after it has been brought under control? What about in subsequent years?

A. Although there is no logical reason why an outbreak should not flare up again if highly susceptible animals remain after it has been brought under control, this is not a common pattern. So, although you should not be complacent and should remain alert, you can probably expect things to remain under control once you have brought them to that state.

Anthrax is a seasonal disease, and you should be alert for the possibility of a new outbreak the next and successive 'anthrax seasons'. In 1990, a significant outbreak of anthrax in Kruger was terminated by the onset of the rainy season in November. No more cases were detected during the summer months, and then in May of 1991 the outbreak re-kindled where it geographically left off the previous year. In general, though, when outbreaks do occur the following year, for example, they generally seem to be smaller and of shorter duration.

They may not occur at all if your actions during and after the first outbreak have been thorough and effective - i.e., you have effectively reduced or eliminated the environmental contamination.

If susceptible populations re-build to high densities beyond what the ecosystem can maintain over a period of years, another large outbreak then becomes a high possibility again.

Don't forget, anthrax is one of nature's "culling agents"; epidemics tend to strike when populations of certain key species become too dense.

II.6 Q. What are the risk factors? Can they be reduced?

A. These range from the obvious, such as a past history of anthrax in the region or the occurrence of cases in adjacent livestock areas, to the less obvious, which include conducive topography (e.g., alkaline, calcium rich soil) and the occurrence of a "typical" rain/drought pattern. Overabundance of an especially prone species with associated habitat degeneration is an important risk factor. The first action should be aimed at minimizing this last factor, the others named being largely beyond human control. In addition, however, actions aimed at ensuring sporadic cases occurring in non-epidemic years are detected, with correct disposal and decontamination to minimize environmental contamination, will certainly reduce the likelihood and frequency of epidemics occurring. Breakdown of livestock vaccination programmes in enzootic areas is a risk factor for both livestock and wildlife.

II.7 Q. What constitutes a well-designed control action plan?

A. In preparedness for a possible outbreak of anthrax (proaction plans) the following items should be in place:

II.7.1 Good surveillance

Rangers, scouts and other staff should

- know and be alert for the warning signs (e.g. cases occurring outside, but near to the management area, development of a high density of any one species in any one location, etc.) signalling the potential for an outbreak and should report them when they occur
- have a plan for responding to warning signs when they occur
- report unexpected deaths and take samples for testing
- have a communication agreement with veterinary and public health services attending surrounding communities

II.7.2 Early detection ability

A capability should be in place for (i) rapid observation and reporting of unexpected deaths and (ii) confirming they are due to anthrax (either an on-site ability to make the diagnosis or a good liaison with veterinary services to ensure they do this without delay).

II.7.3 Plans of action

II.7.3.1 Preparedness for an outbreak

Preparedness for a possible outbreak requires plans and strategies in advance of such an event occurring. These will vary with the size, nature, circumstances and policies of the management area concerned but, in general, will cover

- **Detection** of carcasses (if possible have plans for aerial surveillance in place)
- Immediate (temporary) **carcass management** while the outbreak is active and time to attend to individual carcasses is limited. The aim is to prevent or minimize spillage of body fluids. For this reason, scavengers need to be discouraged. Possibly the best temporary action is to cover the carcasses with canvas or thick plastic to minimize access by scavengers and flies. Spraying the carcass with 5-10 % formalin may be an alternative but scavengers have been known not to be deterred by this
- Subsequent (follow-up) carcass **disposal procedures** (burning is best) and decontamination of the associated ground as soon as possible once it is under control
- Inhibiting advance of the disease front, such as controlled burning of bush, insect control, vulture diversions, core or ring vaccination, dispersion of over-dense groups, movement of susceptible species away from the advancing disease front, closing off water holes, and so on
- The allocation of staff to specific **teams** for implementing the plans of action, including control center and advisory activities
- Distributing **advisory material** to rangers, disposal team members, tourists and local communities on likely hazards, personal protective precautions, consumption of related food (especially meat from animals that have died of unknown cause) and water and considerations regarding prophylaxis
- Contacting off-site **specialist centres** with more advanced support and follow-up capabilities (for culture, serology, strain typing, etc)
- Appropriate **budgeting** for the resources needed, including extra personnel, vehicles and other machinery (e.g. diggers), fuel and maintenance items for these, insecticides, disinfectants, vaccine and vaccination equipment, protective clothing, material for covering carcasses, payments to veterinary and medical services, and educational material.

II.7.3.2 When an outbreak has started

Once an outbreak begins implementation of the plans in III.7.3.1 should go into force immediately. In addition

- An attempt should be made immediately to identify the source of the outbreak and to localize it.
- The likely mode(s) of spread (see below) should be identified if possible and attempts at neutralizing this/these initiated
- The pre-prepared advisory material should be circulated to staff, local communities and tourists

II.7.3.3 When the outbreak is over

Once the outbreak is under control or over

- The plans for disposal of carcasses should go into effect
- The events should be analysed to
 - Identify exacerbating factors during the outbreak
 - The effectiveness of the interventions, including vaccination if done, that were implemented
 - The likely role of flies, carrion, livestock in the region, etc.
 - How all these could be better managed in future
- Unmanaged carcasses resulting from the outbreak can definitely be regarded as sources of possible future outbreaks. The numbers and locations of these should be entered into a risk assessment for future outbreaks
- Off-site specialist centres may be contacted to help with laboratory-based studies which might enhance understanding of the source of the outbreak

II.7.3.4 Q. What is the best way to dispose of a carcass?

A. The preferred method of disposal of an anthrax carcass is burning. Where this is not possible, for example due to lack of fuel, burial is the (less satisfactory) alternative; history has many examples of new outbreaks following disturbance of old burial sites. With burning, it is important to ensure the soil under the carcass is truly scorched also. With regard to burial, the recommendation that the carcasses be buried with lime or quicklime (CaO) is often seen. The origins of this appear to be lost to history. In theory heat would be generated on contact with body fluids and that would thereby be expected to hasten decomposition of the carcass. It is actually uncertain just what lime does to buried carcasses, whether it accelerates their disintegration or actually preserves them and whether it helps or hinders as far as minimizing subsequent environmental anthrax spore contamination is concerned. In either case (burning or burial) consideration may be given to spraying the carcasses and surrounding ground with 10 % formalin to minimize the number of spores which may survive and resurface, causing cases again at some point in the future.

II.8.1 Q. How can I get a diagnosis done?

A. The ideal is a drop of blood from a freshly dead animal smeared on a microscope slide together with a swab dipped into any blood coming out of any orifice placed in a clean container. These should be taken for laboratory examination without delay. Failing these, if the carcass has not been opened by scavengers, a piece of tissue from the ear or eyelid should be collected into a clean container and sent without delay for laboratory examination. If the carcass has been opened, then a swab should be inserted into a bloody area or tissue and placed in a clean container. If possible, specimen collection should be done by someone from your veterinary services, or by a suitably trained microbiologist. If you have to do it yourself, wear disposable gloves and use strong bleach to wipe down the container and any tools, etc., that might have become contaminated by blood or fluids from the animal. It becomes harder to collect a suitable sample the older the carcass gets. An easy diagnosis does depend on the laboratory receiving the sample while the carcass is quite fresh. Once the carcass becomes putrefied or largely consumed by scavengers, diagnosis requires the ability to culture the bacterium that causes the disease, *Bacillus anthracis*. Swabs of the nasal passages, eye sockets or any place congealed blood is still visible are best. Soil samples from the ground where the soil was contaminated by spilled blood will also yield *Bacillus anthracis* on culture. Your veterinary laboratory may not be able to do this themselves but should know where to send the samples, for example the regional or central veterinary laboratory. The problem, though, is that culture takes time and you need to be on the alert for further carcasses in case the first case represents the start of an outbreak.

II.8.2 Q. What samples should we collect? How do we take them?

A. The general answer is given in II.8.1 Remember humans can get anthrax from the careless handling or animals and their remains if they died of anthrax. Preferably get a veterinarian or microbiologist trained in handling disease-causing agents to do the sample collection.

Where this is not possible, or only possible with a substantial delay, the following is extracted from the forthcoming update of the WHO anthrax guidelines which aims to indicate what samples should be collected, how they should be collected, what precautions should be taken in collecting them and what should happen to them thereafter:

- You will need apron or coverall if you anticipate extensive handling of the carcass.
- You will also need disposable covers for your hands and feet (see below) and strong bleach solution

- Dress cuts or abrasions on exposed areas, especially hands and arms
- The professional approach is to wear apron or coverall, disposable gloves and overboots, or boots which can be disinfected. It may be appropriate to wear two pairs of disposable gloves (double gloving); the outer gloves can then be changed as and when needed without exposing the hands. Minimal alternatives are strong plastic bags as overboots and, for the hands, evert a plastic bag, insert the hand that will touch the carcass into the everted bag and grasp tissue to be sampled; insert swab, or cut off sample with other hand; reverse bag over sample or swab and seal and label the bag. In the case of cutting off a piece of tissue, insert the cutting implement into another plastic bag for transport to where it can be disinfected (strong bleach for 1 hour) or sterilized (boiled for 30 min or pressure cooked for 15-20 min).
- After specimen collection, discard disposable items into disposal bags for subsequent sterilisation or incineration. Similarly non-disposable items should be put into discard containers for subsequent sterilisation or disinfection. Care should be taken to ensure sharp objects are in a container they cannot pierce easily. The containers themselves should be sterilised, incinerated or disinfected.
- Wash hands thoroughly with soap and water

Labelling

The following information should be recorded:

- a reference code or number marked in indelible ink on the container

and, either on the container or on a sample documentation sheet

- the date and time of sampling
- the location of the sampling point
- the type of sample
- the reason for sampling
- the identity of the person taking the sample

Samples to be collected

Circumstance	Specimen	Container	Other action
Fresh carcass	Blood from vein (0.1 ml) or, if opened (e.g. by scavengers), dip a dry swab into the blood or body fluids. Failing these, collect a piece of highly vascularized tissue (usually ear clipping)	Blood in syringe can be transferred to a small vial, or left in syringe. Swab back into swab tube or other suitable tube. Tissue into sealable container.	Use for smear on a microscope slide (and, if appropriate, for culture also*). The smear can be prepared on the spot. The slide should be immersed in 95-100 % alcohol for 1 minute and then allowed to dry. It is then 'fixed' and can be kept for up to several days until it can be stained and examined under a microscope. After making the smear with a swab, the swab should be allowed to dry to encourage sporulation for long-term stability en route to the laboratory
Putrefied carcass	Piece of highly vascularized tissue and swabs of vascularized regions (nostrils, eye socket) or of any	Swab tubes. For tissue or soils, sealable	

	bloody material. Bloody soil from under head or tail	specimen containers	
Very old carcass, hides, bones, soil around/under carcass, etc.	Swabs of nostrils, eye sockets. Soil from where body fluids believed to have fallen. The tool used for soil collection should be wiped with a disinfectant wipe before and after taking the sample.	Swab tubes. For soils, sealable specimen container	These will have to be sent to a laboratory able to do the culture work (probably via your local veterinary clinic)

Smear and culture should be done within hours of collecting blood. The bacteria disintegrate in blood held for much more than a day. If a delay in reaching the laboratory is expected, the smear should be made on a slide immediately after collection and the blood should be collected on a **dry swab. This will encourage the bacteria to produce the hardy, long-lasting spore forms (II.8.2) on the swab, which is then reliable for culture for long periods*

Containers for transport

- The specimens should be collected into sterile containers
- The containers should be wiped down with strong bleach and, with outer gloves changed first, put into an outer, secondary container (“double bagged”). If the secondary container is a plastic bag, then this should be of good quality. It should, in turn, be sealed and, for transport, be put into a good quality cool box or a strong plastic or metal container with a lid that can be made secure
- The secondary and outer containers should bear the relevant hazard labels or be clearly labelled “Biological Hazard - open only in laboratory”.

Generally, specimens should be stored at 2–8 °C. Preferably they should be transported in cool boxes, especially in hot weather and when the time interval between collection and delivery to the laboratory is likely to be more than an hour or two.

For shipping of samples by mail or courier, the appropriate procedures with relevant paperwork must be followed. Professional couriers can generally advise.

Disinfection, decontamination and discard

Ideally all specimens and used disposables should be heat-sterilized when finished with. Whether used in the laboratory or in the field, these should have been collected into suitable containers which are then pressure-cooked for at least 30 minutes or held in an oven at 200 °C for an hour, preferably followed by incineration. The containers for microscope slides, coverslips and other sharp items should be puncture-proof.

Contaminated non-disposable items that can withstand heat treatment should also be deposited in suitable containers and ultimately heat sterilized. They can then be washed and re-used. Items that cannot be heat-treated should be disinfected.

Bleach is the disinfectant of choice. Other commonly available disinfectants do not kill anthrax spores. Bleach needs to be quite strong (10 % as a guideline, but remember in some countries the bleach on sale at retail outlets is not very concentrated in the first place. It also needs to be remembered that bleach corrodes metal objects.) An alternative is 10 % formalin and, where immersion is not possible, formalin vapour is effective - but be careful, formalin is harmful on the skin and if inhaled. Exposure times are more than 30 minutes for immersion and 4 hours for formalin vapour.

There may be circumstances where it is appropriate to immerse items in bleach initially and then to heat sterilize and incinerate them later.

Non-disposable over-clothing should be boiled for at least 30 minutes before being laundered. Ideally, non disposable boots should be washed down into a basin or bucket and bleach added to the washings (final concentration 10 %). The boots then should be immersed in strong bleach for at least one hour before re-use.

II.8.3 Q. What data need to be recorded at carcass sites?

A. The following table is offered as a template for recording the information needed for any subsequent follow up.

Sample anthrax case report form

Reference code/No:		Date:		Time:		
Species:		Age:		Sex:		
Location:			GPS coordinates:			
Special relevant features of location:						
Suspected cause of death:						
Signs/symptoms:						
Observations on animal before death:						
Observations of relevance on other animals in vicinity:						
Type of specimen(s) taken:						
Actions (other than taking sample) taken::						
Observer (person taking sample): (Print name):				Sign:		
Laboratory confirmation						
Specimen		Lab No	Date received	Test method	Laboratory (name/location)	Result
No.	Description					
Laboratory representative (signature):					Date:	
Laboratory representative (print name):						

II.9 Q. What are the recommended methods for managing animal carcasses during an anthrax outbreak?

A. This again will vary with the size, nature, circumstances and policies of the management area concerned. Large management areas, with 'hands-off' management policies, and where anthrax is neither rate limiting nor an economic consideration, may leave carcasses unmanaged. Small, commercial or sustainable development management areas may consider the following approaches:

II.9.1 During the outbreak

When the outbreak is active, time to attend to individual carcasses may be limited. Cover carcasses with vegetation or plastic / canvass sheets to discourage winged scavengers and insects until putrefaction has taken

place. Spraying the carcass with 5-10 % formalin may be an alternative but scavengers have been known not to be deterred by this (see also II.7.3.1).

II.9.2 After the outbreak

Once the outbreak is under control (daily case numbers falling off rapidly)

- Plans in place for follow-up carcass management (II.7.3.1) should be implemented
- post-event studies should be carried out to
 - identify more precisely the source of the outbreak
 - assess the effectiveness of the interventions that were put in place
 - identify exacerbating factors during the outbreak
 - assess the likely roles of insects, carrion-eaters, livestock, etc and how these could be managed better in future events.
 - assess the importance of unmanaged anthrax carcasses resulting from the outbreak as sources of possible future outbreaks (see II.7.3.3)
 - assess the effectiveness of vaccination if done
- Specialist centres might be contacted to carry out support studies aimed at a better understanding of the extent to which the disease was present in the area before the outbreak and help identify the source of the outbreak.

II.10.1 Q. Can wildlife be vaccinated?

A. As implied in II.7.3.1, II.7.3.2 and II.9.2, vaccination may be part of a control programme in wildlife. However, the animal anthrax vaccine has to be injected into the animal and, therefore, for practical reasons, it is likely to have to be limited to

- core vaccination of valuable or endangered species or particularly high-risk populations or
- ring vaccination of susceptible populations in an area surrounding the area where the outbreak is active or in front of the clear direction of advance of the outbreak

Depending on local circumstances, initiative may be needed to devise a way of vaccinating substantial numbers of wild animals. (Oral vaccines are not available).

II.10.2. Q. How, in practice, can we go about vaccinating wild animals?

A. Many wildlife parks are equipped with dart guns for immobilising animals. For ‘core vaccination’ endeavours (i.e. ensuring that a core group of a particular species has been vaccinate), the best approach may be to immobilise the chosen number of animals and vaccinate them with a standard syringe while immobilised. It is possible also to load darts with the vaccine so that they deliver the vaccine rather than the immobilisation drug. This can be done from capture vehicle or helicopter if the costs can be borne and good marksmen are available. Such tests as have been carried out in rhino indicate that this is effective in producing immunity (Turnbull et al, Vaccine 2004; 22:3340-7). For vaccinating large numbers of animals, the Malilangwe Trust in Zimbabwe took the successful and economic approach of corralling the target animals and injecting them with syringes affixed to the end of long poles. The possibility of deaths from handling stress must be borne in mind.

II.10.3 Q. Where can we get the vaccine from?

A. A list of vaccine producers is given in Appendix V of the 1998 WHO anthrax guidelines http://www.who.int/csr/resources/publications/anthrax/WHO EMC_ZDI_98_6/en/ (update due in early 2007).

II.10.4 Q. In choosing to carry out core vaccination, what percentage of a population should be vaccinated to ensure survival of the species in our management area?

A. This is a bit of a “*how long is a piece of string?*” question. Obviously it must be a balance between the most you can manage and the overall size of your population. It may not be appropriate to think in terms of a percentage. If the most you can manage to vaccinate is 50 animals, then the proportion is going to be different if your population is 100 or 1000. More important is to consider how many must live to protect your gene pool and what the proportion of males and females should be.

II.10.5 Q. If our principal concern is to protect Endangered Species A, what approach should we take to vaccinating other susceptible species in our management area?

A. It is one of the odd and largely unexplained phenomena about anthrax outbreaks that they tend to affect one species predominantly, although sporadic cases may occur in other equally susceptible species in the vicinity. So the important thing would appear to be to concentrate on bringing the outbreak in the most affected species to a halt. As covered in II.4, II.6 and II.7, this involves more than vaccination. However logic suggests that, if time and resources permit, there may be something to be gained from vaccinating more than just the predominantly affected species.

II.11 Q. Why did an outbreak happen?

A. A number of reasons are possible. Anthrax may have been occurring sporadically in the area unnoticed with deaths either not observed or attributed to other causes. Alternatively it may have been introduced by scavengers or flies from outside the management area from livestock cases occurring there. Less likely, but conceivable, is that it was introduced from some distance away by vultures or, even more remotely possible, by wind or flowing water, or scavengers/flyes navigating along waterways.

II.12 Q. Could it have been prevented? Why wasn't it?

A. Alertness to the possibility that anthrax existed in the management area both in its past and at the present time might have ensured that control measures were in place that might have prevented, or at least limited the extent of the outbreak. Similarly, alertness to the existence of the disease outside the management area through efficient communication with veterinary and medical/public health services and with local communities bordering the area may have enabled limitation actions to be implemented. There are presently no measures which can guarantee to prevent an outbreak in a wildlife management area in endemic regions of the world, but the measures detailed in II.4 may certainly go a long way towards that.

Anthrax persists not just from obvious big epidemics, which can attract improved control activities, but also from sporadic deaths that maintain soil contamination. It is thus important to diagnose random wildlife deaths, and, when a carcass tests positive, to dispose of it properly.

One approach to prevention of anthrax in white-tailed deer in the USA has been to put out feed laced with 30gms of tetracycline per ton. This has not resulted in development of antibiotic resistance problems.

III. Risks to humans from wildlife anthrax

III.1 Q. Am I and my family at risk of getting anthrax from infected wildlife?

A. Unless you, or a member of your family, handle carcasses of, or specimens from, animals that have died of anthrax, the chances of any member of your family contracting the disease is very remote to non-existent. There are a few documented cases of biting flies transmitting a cutaneous infection to a human in the vicinity of a carcass, or carcasses, but this is very rare and would be very unlucky. It is more common for a cutaneous case to arise from scratching an insect bite with a contaminated finger following handling an anthrax carcass.

If you, or a member of your family, are involved in the management of anthrax carcasses, then a greater risk of acquiring cutaneous anthrax exists. This can be minimized to next-to-zero by taking the appropriate precautions given in III.10 below, and particularly washing your hands immediately after dealing with the carcass.

In the unlikely event that you, or a member of your family, have occupations which involve handling dry hides, bones or other dry animal materials that may have emanated from anthrax victims, then respiratory protection is advisable as well as the other standard precautions. In countries where a human vaccine is available, vaccination makes sense (see III.18). (Remember, carcasses of animals dead from anthrax should have been incinerated and, therefore, hides and bones from such animals should, under ideal conditions, not be there).

Humans are fairly resistant to infection, so even when exposed to small doses for short periods, the chances of infection are low

III.2 Q. What are the symptoms of human anthrax?

A. III.2.1 Manifestations of anthrax

There are three manifestations of anthrax in humans. All three are potentially fatal; medical evaluation and treatment are essential for all of them.

- Cutaneous, or skin anthrax is by far the most common form. About 99 % of cases that occur are of this form. It is usually contracted when a person with a break in their skin, such as a cut or abrasion, comes into direct contact with the anthrax organisms. The resulting itchy bump rapidly develops into a black sore. If the infection spreads from the sore, headaches, muscle aches, fever and vomiting may develop; this is a dangerous sign of the development of whole body involvement which, in the absence of timely treatment, may be quickly followed by sudden onset of confusion, shock and death. The case fatality rate without treatment is 10-20 %; with treatment it is 0 %.
- Ingestion, or oral route anthrax, usually acquired from eating meat from an infected animal, takes two forms – the oropharyngeal form, in which the anthrax sore is localized in the mouth, or on the tongue, back of the throat or tonsils, and the gastrointestinal form, where the sore may occur anywhere within the stomach or intestinal tract, but mostly in the lower intestinal tract. In the former, the sore is likely to be visible in the mouth or throat and accompanied by sore mouth, tongue or throat, swollen tonsils and swelling of the neck, possibly extending down to the chest. There is a danger of asphyxiation from compression of the respiratory tract. The case fatality rate is estimated to be 30-60 % even with treatment
- Inhalational (pulmonary) anthrax, in its natural form, is an occupational disease acquired by inhalation of spores released during industrial processing of spore-laden animal materials, such as wool, hides, bones, etc. from animals that have died of anthrax. As a naturally acquired infection, it is very rare, but it is the form feared most in relation to bioterrorism. The case fatality rate is estimated at more than 90 % even with treatment.

III.2.2 Symptoms

For the three forms of the disease (as described above), the symptoms are:

- Cutaneous anthrax – the characteristic sore (“eschar”) which starts as a pimple around which a swollen ring of fluid-filled tissue develops over about two days. The fluid may leak out and does contain the bacterium. There is extensive swelling around the eschar from accumulation of fluid. This can be dangerous if the sore is on the face or neck as it may ultimately prevent breathing. Over the next few days the centre of the sore turns ulcerates and turns black. If the patient has been treated or the infection is uncomplicated, this will gradually cure, and the surrounding swelling will go down again. A scar may remain. The sore can vary very greatly in size from about 1 cm to 10 or more cm.
- Ingestion anthrax – the oropharyngeal form manifests itself as the sore appearing in the mouth or back of the throat with marked swelling of the face, neck and thorax. Symptoms of gastrointestinal anthrax include nausea, vomiting, loss of appetite, mild diarrhoea and fever. With either form, if not treated early, there is a serious danger of whole body involvement with rapid onset of confusion, shock and death.
- Inhalation anthrax - Early symptoms resemble those of ‘flu, with fever, chills, sweats, fatigue and cough. Again, if treatment begins too late the condition rapidly deteriorates with onset of confusion, shortness of breath, shock and death.

III.3. Q. How long after exposure can one expect the signs to appear?

A. In cutaneous anthrax, the sore usually appears 2 to 6 days after exposure to the spores, but cases have been recorded when it has appeared after 9 to 12 hours. Similarly, symptoms of ingestion anthrax can generally be expected to manifest themselves about 2 to 6 days after consumption of contaminated food. With inhalation anthrax, symptoms mostly appear approximately 4 days after exposure but can appear later than that and as early as one day.

III.4 Q. Is anthrax easy to diagnose?

A. The cutaneous form is readily recognized by a doctor or nurse who is familiar with it. So, in countries where anthrax is encountered frequently, it is easily diagnosed. Elsewhere, the doctor or nurse would probably need to know the occupation of the patient, or be given some other fact that would raise their suspicion that this is anthrax. An infected cut that is inflamed with small blisters but is painless, or just itches, and is accompanied by marked swelling of the surrounding region should raise suspicion. Lymph nodes in the armpit or groin may also be enlarged.

In countries where an animal that has died suddenly is likely to be cut up and eaten, medical personnel should consider ingestion anthrax in their diagnosis when a sick person comes to them.

Inhalational anthrax is only a possibility in a person who works with hides, bones, wool, etc.

Diagnosis in the absence of a suggestive ‘patient history’ can be very difficult.

III.5 Q. I feel “flu-ey”, or that I have a cold coming on. How do I know it isn’t anthrax?

A. Only people who have been directly exposed to the spores can catch anthrax. In natural situations, the spores will only occur in places where materials from animals that died of the disease have been placed or handled. If you have had no skin sore and no reason to believe you have eaten uncooked, or poorly cooked meat from an

animal that has died of anthrax, or been substantially exposed to a lot of dust from animal hides or bones from animals that may have died of anthrax, then you can be sure your 'flu-ey' symptoms are not anthrax.

If you think you may have been exposed and feel unwell, you should get medical advice in the normal manner but without delay, explaining to the doctor when and how you think you may have been exposed. The doctor will then be able to advise you and prescribe the most appropriate treatment

III.6 Q. Can anthrax be treated?

A. If given early in the infection, anthrax is readily treated with antibiotics and a doctor or suitably qualified nurse should be seen without delay. Penicillin has long been the drug of choice but the doctor has a wide range of alternative "broad spectrum" antibiotics to choose from if there is reason to believe penicillin is unsuitable, or that simultaneous administration of more than one antibiotic is advisable. The cutaneous sores take days or weeks to heal completely and patience is required. Antibiotic treatment can be stopped after 4 to 7 days even if the sores still look awful.

III.7 Q. What is the chance of me dying if I get anthrax?

A. As said above, treatment is easy and effective if the diagnosis is made and treatment administered early enough. Cutaneous anthrax is fairly easy to diagnose if patient and medical officer are alert to the possibility. Ingestion anthrax, with early symptoms of food poisoning, and inhalational anthrax, with flu-like symptoms to begin with, are harder to diagnose. And that is where the problem lies. It appears that about 10-20 % of untreated cutaneous cases can be expected to be lethal; ingestion anthrax is likely to have a higher chance of being fatal, probably about 30-60 %. Inhalational anthrax has a very high chance of being fatal if treatment is not begun early enough.

III.8 Q. Can I catch anthrax from someone else?

A. Circumstantial and historical evidence indicates that humans are moderately resistant to infection by *Bacillus anthracis* and the disease is not considered contagious; records of person-to-person transmission of the cutaneous form of the disease exist, such as when a person changes the dressing of an anthrax sore without due care, but this is very unusual. Ingestion anthrax can only be contracted by consuming anthrax spores and inhalation anthrax only by directly inhaling anthrax spores. A person with ingestion or inhalation anthrax would not be able to transfer the disease to someone else.

III.9 Q. Will I or my family be quarantined or isolated?

A. Because anthrax is not contagious (see above), there is no need to quarantine the individual or family, or other contacts.

If a person does have anthrax, it would be important for other persons who may have been in contact with the same source of the infection (e.g. animal carcass) to inform a medical officer and report the development of any sore or illness in the next two weeks.

III.10 Q. How can we protect ourselves?

A. Avoiding anthrax amounts to sensible 'barrier' precautions. Extreme measures ('space suits') are not necessary. Remember, the disease is not contagious and generally a fairly large dose of infecting organisms is needed to establish an infection in a human.

If you are not directly involved in any way with local cases that are occurring, simply be sure that meat, hides, bones, etc from the animals that have died do not come onto your property. Although the chances of flyborne infection are remote, apply extra care to avoid insect bites during the outbreak. Heat (cook, boil, etc) or disinfect (10 % bleach for 1 hour) any materials or items you are suspicious of.

If you are directly involved in some way (e.g. helping to burn the carcasses), then be sure any cuts, scratches, etc. are well dressed, wear boots, gloves and outer clothing that can be disinfected and washed or burnt after use.

There is no need to take antibiotics or to try to get vaccinated.

III.11 Q. I'm worried about anthrax. Should I take antibiotics just in case?

A. Get medical advice first. You need to be given the right antibiotic and to know the correct dose, how often and how long to take it, and so on. Also, by taking antibiotics unnecessarily or the wrong antibiotics, or the wrong dose of an antibiotic, you may upset other normal body functions, especially your digestive system.

III.12 If someone is exposed to blood or meat from an infected animal, what should they do?

A. Those parts of the body that have been in contact should be washed well with soap and water. If the skin is not broken and it is an insensitive part of the body, rinsing in 10 % household bleach may have added disinfection value. This should not be done for sensitive areas (round the face, eyes, mouth, etc) or if the skin is broken at the exposed site. The washings are best disinfected by adding bleach to a final concentration of 10 % and leaving for an hour before discarding.

If the skin is broken at the exposed area, you should inform your medical adviser who will decide if you should be given antibiotics as a precautionary measure. In any event, you should consult your medical adviser immediately if unexpected spots or inflamed area with blisters develop at the exposure site over the next two weeks.

Contaminated clothes should be thoroughly disinfected, sterilized or burnt. Disinfection can be done by prolonged immersion (several hours) in 10 % bleach, or boiling for an hour or autoclaving (pressure cooking) for 30 minutes.

The meat should be destroyed by burning. Local veterinary and public health officials should be made aware of the situation if they are not already.

III.13 Q. Can anthrax be spread by fly or mosquito bites?

A. Technically the answer to this is 'yes', but that has to be qualified by a number of considerations. Firstly, the insect must have collected and carried a sufficient dose from the animal that has died of anthrax. Remembering that humans are, on average, fairly resistant to the disease, this immediately reduces the likelihood of a person contracting it this way. Multiple bites from several or numerous biting insects may raise the chance. Secondly, evidence suggests that the ability of an insect to transmit anthrax decreases fairly rapidly with time and becomes negligible after some hours have elapsed since the insect fed on the victim's blood. Thirdly, the distance the insect has to travel is pertinent. On the whole, although there is evidence that cutaneous cases can occur in humans from fly bites, it is a rare event.

III.14 Q. How can I be sure my drinking water is safe?

A. The evidence is that when the anthrax bacterium is shed into water by an animal dying there, it does not survive well (it doesn't have the chance to form the persistent spores). So the likelihood of highly contaminated water is low at the outset. With the dilution factor and, if your water is passed through a filter bed, the effect of this, by the time the water reaches your tap, it is very unlikely to have any hazard. Standard chlorination plays little part in this since, once the spores are formed, they would be resistant to the levels of chlorine in drinking water. If there is reason to think your water may be substantially contaminated with anthrax spores, boil it for at least 15 (preferably 30) minutes.

III.15 Q. Can I be infected by contact with soil?

A. While there are very rare cases where cutaneous infection is thought to have been acquired while gardening, this has been attributed, when it has happened, to bonemeal being applied as a fertilizer. One instance is known of individuals contracting anthrax when salvaging scrap metal at a disused automobile factory where anthrax carcasses had been buried. But direct human infection from old carcass sites is exceedingly unusual. However, this is not a reason for handling soil from such sites without sensible precautions, such as wearing gloves which are disinfected or disposed of after use, ensuring no cuts or scratches are exposed to the soil, and so on.

III.16 Q. Is it safe to eat meat from anthrax infected animals if I cook it well?

A. All parts of the carcass of an animal that has died of anthrax should be incinerated, so this question should not really arise. The primary risk of infection would come from handling the meat before cooking and the contamination of utensils and recontamination of the cooked meat by putting it on the same cutting board as was used before cooking. Well cooked meat itself would be unlikely to result in infection, but it has to be stressed again, you should not have meat from an animal that has died of anthrax in the first place.

III.17 Q. Is the milk from my cows safe to drink?

A. Occurrence of anthrax in wildlife in the region is not a reason for concern as far as drinking milk from your own cows. Even if one of your animals has died of anthrax, the milk is unlikely to be unsafe to drink, but you should at least pasteurize it. If in doubt, boil it before consumption.

III.18 Q. How is anthrax prevented? Is there a vaccine for humans?

A. Vaccines for general public use are not available. Control of the anthrax in humans is normally based on prevention of the disease in their livestock (mainly cattle, sheep, goats, horses), good hygienic practices when an animal does die of anthrax and antibiotic treatment when a case occurs in a human.

Human anthrax vaccines do exist but are only produced and licensed for use in China, the Russian Federation, the UK and the USA. Even in these countries, their use is restricted to persons in occupations with a high risk of exposure to the disease, such as certain laboratory workers, workers in animal processing industries or military personnel.

If your medical officer believes you may have been seriously exposed to anthrax, he/she may put you on an antibiotic as a safeguard.

IV Risks to livestock and pets from wildlife anthrax

IV.1 Q. Can my pets/livestock get anthrax from the affected wildlife?

A. IV.1.1 Pets

The only way pets kept at home might be expected to contract anthrax would be if meat from one of the anthrax carcasses got fed to them. Dogs or cats running loose and scavenging carcasses or licking spilt blood can develop the disease and there are instances on record of this occurring, but these animals are, by nature, quite resistant to anthrax infection and normally it is unlikely to occur.

IV.1.2 Livestock

Firstly, livestock most at risk are the browsers and grazers - cattle, sheep, goats, equines and camels; also ostriches. Pigs may also be at risk if fed parts from animals dead from anthrax or contaminated commercial feeds. Poultry and pets are not at significant risk.

The risk to susceptible livestock depends on the degree and manner of intermingling of the domestic and affected wild animals. Livestock grazing over carcass sites of anthrax victims, whether wild animals or other domestic ones, are at a real risk of contracting the disease. In the event of an outbreak occurring nearby, whether in wild or domestic animals, if your animals cannot be kept isolated from the affected animals, you should have yours vaccinated at the earliest opportunity. You should, furthermore, consider re-vaccinating them annually until no further cases occur in your district, best for 3 years after your last case.

Generally isolation is sufficient to prevent transmission from cases to other animals. There is reason to suspect that biting flies can transmit the disease. If cases are occurring in your district at a time when biting flies are especially plentiful, you should again consider vaccination of your animals. Scavengers (hyenas, jackals, vultures, crows, marabou storks, etc) may transmit anthrax spores from carcasses to other sites. The degree to which this contributes to the spread of the disease is not known but it needs to be thought about in planning for outbreaks and in vaccination strategies.

IV.2 Q. How would I know my animal has anthrax? What do I do?

A. Firstly, occurrence of anthrax in pets is very unlikely. It is primarily a disease of herbivorous livestock, particularly cattle, sheep, goats and horses. Sometimes outbreaks occur in pigs, though they are generally more resistant than truly herbivorous animals. Although the disease has been reported in zoo birds inadvertently fed meat from an animal that has died of anthrax, outbreaks in domestic fowl (chickens, ducks, geese, etc.) do not occur. Outbreaks have occurred in mink, again following eating meat from an animal that has died of anthrax.

The first sign in livestock is unexpected death. The animal looks normal and then, a few hours later, is dead. There may be blood oozing from the mouth, nose or anus, though this is not always seen and apparently is not seen at all in some species. In this event, do not touch, handle or move the carcass, but fence it off in some way to prevent other animals coming into contact with it and immediately call a livestock veterinarian or your local agriculture ministry office. They will arrange for the necessary action to be taken and advise you what must be done. Lightning strike and other possible (and probably more common) causes of sudden death will need to be considered.

IV.3 Q. If any of my animals develop anthrax, can they be treated?

A. Anthrax is very responsive to antibiotic treatment if this is administered early in the course of the infection. In the case of livestock, once an outbreak has started all exposed livestock should be first treated with a long-acting antibiotic to stop any incubating infections; after 7-10 days (to allow the blood levels of antibiotic to drop away), vaccinate them (see also IV.5).

IV.4 Q. Why does my herd need to be quarantined for such a long time?

A. This applies to your livestock if a case has occurred in one or more of your animals. The quarantine is aimed at preventing contact between infected and non-exposed animals for at least 14 (preferably 21) days after the last case. This is because the incubation period of the disease in any one animal is a little unpredictable but if a case has not occurred by the 14th day after vaccination, you are fairly safe in believing that no more cases will occur in that herd (unless re-exposed to a contaminated site).

IV.5 Q. What can I do to protect my animals against anthrax?

A. If anthrax cases are occurring near your livestock and this seems to represent a spreading outbreak, the best precaution you can take is to get your veterinarian to vaccinate them. Otherwise, keep your livestock from wandering in the same areas as the affected animals. Be on the look out for any of your animals showing signs of illness. If they do, obtain antibiotic treatment (penicillin best) at the earliest possible opportunity. If it is anthrax, an hour's delay can be fatal.

IV.6 Q. If I vaccinated my animals last year, will they be safe this year?

A. Circumstantial evidence suggests that if you are in an area that sees anthrax regularly, or you have other reason to believe outbreaks may occur in your vicinity, you should re-vaccinate each year. In fact, the second dose will be more effective than the first (this is true of all vaccines).

V. Other questions**V.1 Can anthrax be eradicated?**

A. If anthrax was a disease confined to livestock, it could be eradicated by vaccination and incineration of carcasses. However this is sometimes impractical in wildlife. In the opinion of many wildlife workers, it is actually an integral part of the ecosystem – “nature’s culling agent” for populations that are becoming too dense. As such, those holding this view consider attempts at eradication would be undesirable. There are considerable geographical and intersectoral (e.g. livestock versus wildlife managers) differences in opinions on this.

V.2 Q. Why is anthrax usually the first disease named in discussions on bioterrorism or biowarfare?

A. The bacterium *Bacillus anthracis* forms “spores” which few other disease agents do. The bacterial spore is a resting form of spore-forming bacteria in which the life essentials of the bacterial cell are packaged in a dehydrated state within a central core surrounded by thick protective layers which render the spores highly resistant to biological extremes of heat, cold, desiccation, chemicals (including disinfectants), irradiation, and so

on. They can, therefore, survive the heat and blast force during detonation of the bioweapon and also environmental factors that would kill other microbial agents in a fairly short time, such as ultraviolet light from the sun, drying, heat, and so on. Ease of production and the potential severity of the resulting disease in humans and livestock are also considerations.

V.3 Q. Is there a difference between the disease as encountered naturally and when it results from a terrorist or warfare event?

A. It is important to clearly distinguish natural and bioaggression situations: the massive and overwhelming exposure doses that can be created in man-made, deliberate release scenarios cannot be remotely copied by nature. In addition, “weapons grade” anthrax spores are treated to ensure that they electrostatically repel one another, and thus aerosilise with ease. The potentially much more severe epidemic that could result from a biowarfare or bioterrorist act would be a much greater challenge to bring under control. The natural disease is readily controllable. This also explains why there is no conflict between, on the one hand, the statements that humans are moderately resistant to anthrax infection and, on the other hand, the choice of anthrax spores by an aggressor.

VI. Further advice and information.

VI.1 Q. Where can we get further advice? Who can we talk to about this?

A. The IUCN SSC Veterinary Specialist Group has a list of appropriate advisers. Contact co-Chairmen: William Karesh (based in the USA) at contact@iucn.org or Richard Kock (based in the UK) at Richard.Kock@zsl.org. Richard Kock's phone number is +44 207 449 6483 and fax is +44 207 483 4436.

Other contacts:

The following would be happy to advise:

Roy Bengis, Kruger National Park, South Africa: Email: RoyB@nda.agric.za. Phone: +27 13 735 5641

Martin Hugh-Jones, Louisiana State University, USA. Email: mehj@vetmed.lsu.edu. Phone: +1 225-578-5599

Pauline Lindeque, Ministry of Environment & Tourism, Namibia. Email: p.lindeque@mweb.com.na. Phone: +264 61 2842111

Peter Turnbull, Salisbury, UK: Email: peterturnbull@tesco.net. Phone +44 1722 333828.

VI.2 Q. Should we bring in an expert to manage the situation?

A. The experience gained from recent outbreaks in Africa has shown that problems with early reliable diagnosis and then lack of an action plan in advance of the event have contributed greatly to the size and extent of the outbreak. Ideally, the presence of an expert would be expected to reduce the size and extent of the outbreak but, in practice, organising and waiting for such a person to arrive is likely to take too much time for him/her to be of much help at the outset of the outbreak. The cost factor is also important. Much can be achieved by making the right contacts rapidly and even more by having action plans in place. A good link for this is www.cdc.gov/ncidod/eid/vol12no07/06-0458.htm (subject: Preparedness for Anthrax Epizootics in Wildlife Areas).

Experts are also valuable in the follow-up to an outbreak, advising as to how to trace the source of the outbreak, the effectiveness of interventions and what to expect in the future.

VI.3 Q. Where can read up on the subject?

A. The most readily available on-line general text is the 1998 WHO anthrax guidelines on http://www.who.int/csr/resources/publications/anthrax/WHO EMC_ZDI_98_6/en/
An updated edition is in preparation and expected out in the first half of 2007.